Extreme events and financial system governance: some lessons from the crisis

Joachim Keller
Peter Praet

Introduction

The consequences of the current financial and economic crisis can clearly be described as catastrophic. In the wake of losses on risky subprime loans and related structured finance products, several financial institutions and with them the entire financial system came close to collapse and could only be saved by concerted emergency measures by governments across the world. However, the overall costs of the crisis are huge: most financial institutions have incurred massive losses and shed jobs in large numbers. Most economies around the world have slipped into recession or their growth has slowed down drastically. The rescue measures and aid packages that were necessary to prevent the banking system from collapsing will impose a large burden on governments' budgets and ultimately on taxpayers.

The catastrophic consequences of the current crisis have put tremendous pressure on financial policymakers to take measures to minimise the likelihood of such crises in the future. In this context, it is important to understand more about the nature of crises, or extreme events as they are referred to in risk managers' parlance, in the financial system. Like other catastrophic events (such as natural disasters), an extreme event in the financial system can be described as an "event producing a subversion of the order or system of things; a final event, usually of a calamitous or disastrous nature".[1] It is worth highlighting three more specific characteristics of extreme events in the financial system. First, the way they propagate through the financial system depends on the interdependencies between and behavior of financial institutions. They also often arise endogenously from within the system. Second, the probability of such events is extremely low. That is, the financial system is able to absorb many different imbalances and shocks, but very occasionally a shock or imbalance is too large for the system to absorb and the consequences can be catastrophic. The extremely low probability also implies that there is no market price for the risk of extreme events. Third, the overall costs of extreme events can be very high and tend to extend beyond those segments from which they originated.

Bearing all this in mind, what has gone wrong in the financial system? This article assesses two main factors that may explain how this crisis could have happened. The first focuses on the weaknesses of risk models and the difficulty to capture the systemic complexities and interdependencies within the financial system. In other words, it is hard to measure the probability of extreme events and how they play out because they arise endogenously and occur only very infrequently. The second factor relates to the incentive of financial institutions to ensure their resilience to extreme events. Indeed, due to the extremely low probability of such events and the low individual costs relative to the total costs of a crisis, financial institutions have individually little incentive to ensure that they are collectively robust.[2] In other words, they do not "internalise"

(1) Collaborative International Dictionary of English (CIDE).

(2) This article refers to "investment in robustness" when describing the efforts of financial institutions to limit risk-taking and to reduce their vulnerability to adverse market conditions. Such efforts might include not relying blindly on simplistic models but making decisions based on a deeper and critical risk analysis (using "own judgement"). Throughout the article, the expressions "under-investment in robustness" and "excessive risk-taking" are used synonymously.

the external costs, or negative externality, they impose on the system in case of failure.

The analysis of the causes of the crisis will also be useful in discussion of the appropriate regulation of the financial system. In order to minimise both the risk of individual failure and the risk of events of a catastrophic dimension, the goal of regulation must be (either by improving incentives or setting rules) to ensure that financial institutions invest sufficiently in their robustness and to facilitate a proper appreciation of systemic risk through adequate modelling.

This article is structured as follows. Section 1 focuses on the weaknesses of risk management models and highlights some systemic properties of the financial systems that have hitherto not been sufficiently addressed. Section 2 discusses the question of whether financial institutions have sufficient incentives to invest in robustness and to protect themselves against catastrophic events. Section 3 provides some examples of policy proposals that aim at reducing the risk of extreme events in the financial system. Section 4 concludes.

1. Modelling risk of extreme events

Many commentators blamed risk models for playing a major role in the crisis. Risk models are supposed to help provide financial institutions' decision-makers with an accurate picture of the risk they face and to guide them in making risk-relevant decisions. However, risk models have failed in this crisis; they did not prevent institutions from accumulating excessive risk and did not seem to detect the large amount of 'hidden risk" that loomed in the financial system before the outbreak of the crisis.

Criticisms of risk models mainly fall into two categories: First, the models are vulnerable to "model risk", as their output depends crucially on a series of statistical assumptions. Second, they do not take into account the fact that risks in the financial system are partly endogenous. In other words, models were rather suited to assess the short-term risk of a given financial institution under the assumption that fundamental system characteristics remain stable. Hence, they addressed micro-prudential concerns, which focus predominantly on the stability of individual institutions.

However, such an approach is not well suited to assessing systemic risk and the risk of catastrophic events in a financial system. A top-down approach should be added, where the assessment and modelling of risk is derived from overall system properties. The next sub-section highlights the main shortcomings of the models in use. The following sub-section discusses some fundamental characteristics of the financial system and how they contrast with the current practices for dealing with systemic risk.

1.1 Examples of shortcomings of current risk models

With respect to estimating the probability of extreme events, the main shortcomings of the models have been the following:

Excessively short-term horizon. Risk managers often fed the models with only relatively recent data. Since extreme events occur only very infrequently, such practices imply that relevant data from previous extreme events tended to be neglected ("short-term memory" or "disaster myopia" of risk models). This characteristic also makes risk models cyclical, since they become more lenient in boom times when recent data covers periods of low risk and default rates.

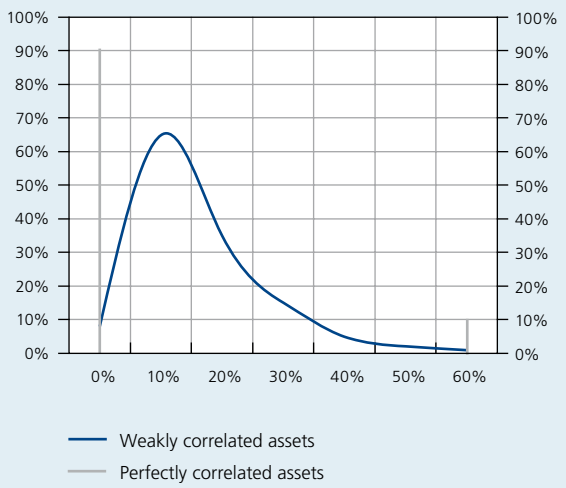
Arbitrary and inaccurate model assumptions. Risk modellers must make assumptions on statistical distribution to measure extreme events because they represent "tail risk". In theory, the appropriate statistical distributions should be selected according to the "fatness" of the tail. However, in practice, the fatness of the tail is rarely known and hence the choice of probability distribution is prone to errors. Often, risk managers use the standard normal distribution, although this distribution may produce a tail that is not fat enough. Indeed, some commentators argue that the systemic nature of extreme events in the financial system implies that tail risk is even higher than previously thought.[1] The choice of statistical distribution has a significant impact on measures such as VaR, leading to some degree of arbitrariness of the results (see Daníelsson, 2008).

Invariant market structure. Another fundamental shortcoming of risk models is their implicit assumption that the underlying market structure and behaviour of actors is given and invariant over time. For instance, financial institutions insufficiently considered the likelihood of other institutions experiencing the same shocks and drawing similar conclusions, with a further impact on asset prices and liquidity. Similarly, widely used methods to estimate important inputs in risk models such as default or asset price correlations have relied on the assumptions of robust relationships over time. For instance, the measurement of default correlations by Gaussian copula functions relied

(1) FSA (2009); El-Erian (2008); Landau (2008), Haldane (2009), Acemoglu (2009).

CHART 1 THE EFFECT OF CORRELATION ON THE RISK PROFILE OF A CREDIT PORTFOLIO

(Probability distribution of portfolio losses)



on past data and therefore implicitly assumed that the correlations would remain stable. However, default correlation may vary over time and tend to increase significantly in times of stress.

Figure 1 illustrates the impact of correlation on a loss distribution. It depicts the loss distribution of a fictitious credit portfolio (credits with default probability of 10% and recovery rate of 40%) with two scenarios of differing correlations of default probability. In the case of low correlation, the portfolio owner faces relatively small portfolio losses most of the time, but the probability of either zero or very high portfolio losses is relatively low. In the case of perfectly correlated default probabilities, the owner faces either zero losses (probability of 90%) or a loss of 60% of the portfolio in case of default (probability of 10%). Thus, the owner faces very low or very high losses with a relatively high probability. Hence, an incorrect assumption of the correlation may lead a risk manager to underestimate the magnitude of loss in the case of a severe shock. In other words, a portfolio of highly-correlated assets is more vulnerable to extreme events. Hence, correctly estimating correlation is crucial for risk managers. Prior to the present crisis, risk managers dramatically underestimated the default correlations of certain structured finance assets and therefore took on much more systematic risk than anticipated.

1.2 Financial systems as complex adaptive systems

In order to improve modelling of systemic risk and extreme events, it is necessary to understand better how a financial system behaves and how it can be made more robust. This requires focusing on the overall systemic behaviour rather than just on the behaviour of individual institutions. For this purpose, it may be useful to think about financial systems in the same way as biologists or engineers think about systems such as ecosystems or complex electricity networks.

Financial systems can be described as "complex adaptive" systems. That is, the system participants are interconnected in a complex way, follow their own objectives and adapt in an uncoordinated way to changes in the environment. A main feature of such systems is that they generate some specific, system-wide outcomes, which cannot be explained by the behaviour of individual institutions. Thus, the so-called "composition fallacy" applies (Landau, 2008). An important implication is that the risk of extreme events and how they play out cannot be appreciated by looking at individual institutions alone. A corollary is that robustness of the system emerges form the collective action by financial institutions and cannot be engineered (such as in simple systems (e.g. heating systems) where behaviour of components can be more completely controlled). (1)

In the long run, a major driving force in the complexity and dynamic nature of the financial system is innovation, often following from strategies such as regulatory arbitrage by financial system participants. This implies that the financial system is constantly evolving, which makes it difficult for the institutions or banks themselves to obtain a reliable picture of the risk inherent in the system. For instance, the initial success of certain structured finance products led market participants to believe that the risk associated with these products was relatively low. Now, those involved have learned that their risk assessments were deeply flawed. Regulatory arbitrage also implies that regulatory measures may become obsolete and actually generate new risks.

In the short run, quick adaptations to changed market conditions also bear the potential for unexpected and hard-to-predict behaviour of the system. In fact, the short-term strategies used by financial institutions in an extreme event often tend to aggravate the stressed market conditions.

(1) Kambhu, Weidman and Krishnan (2007)

1.3 Some properties of financial systems as complex adaptive systems

This section discusses some key properties of financial system behaviour. Financial policy-makers ultimately need to find ways to take account of these properties, as in many cases, financial institutions cannot adequately deal with them alone. In other words, a systemic approach to regulation is needed.

Non-linear relationships. In the event of an extreme event, financial sector stakeholders may abruptly change their behaviour, which may result in a regime shift, or a "jump", to a different equilibrium. This leads to sharp variations in asset prices, correlation between asset prices, and volatility. For instance, actors may learn in a crisis that their risk assessment was wrong and become extremely risk averse before they can update their assessments (flight to quality episodes).[1]

Also implied by non-linear relationships are **multiple stable states** and **path dependence**, which play an important role. The former implies that after a shock, financial institutions may react in a way that locks them in a suboptimal market equilibrium from which they are unable to move to another equilibrium where they would collectively be better off. Path dependence implies that the recovery path will be a function of the particular conditions leading to the shock; therefore, the system may look very different even after recovery.

Contagion. In financial systems, losses incurred at a single institution or in a certain segment can translate into a system-wide crisis by causing funding withdrawals and the evaporation of liquidity, ultimately leading to cascading losses due to asset fire sales. Thus, contagion means that shocks which initially hit only one or a few institutions can propagate through larger portions of the system through reinforcing feedback loops.

Synchrony. For several reasons, financial institutions may fall into step and make similar choices, akin to shoals of fish or flocking birds. In the build-up of a bubble, for instance, financial institutions often tend to rely on "the market" rather than on their own judgement, thereby inflating an asset price bubble even further. More profoundly, the fact that financial institutions use similar risk models may also contribute to synchronised behaviour, both in the build-up of a bubble and in a crisis, when the institutions discover simultaneously that the models are flawed. In addition, peer comparison and benchmarking as well as decision-making under uncertainty contributes to synchronic behaviour.

(1) See Caballero and Krishnamurthy (2008) and Rigotti and Shannon (2005).

Box 1 – The importance of liquidity: maturity mismatch, liquidity risk and financial contracting

All financial institutions that act as intermediaries between lenders and borrowers rely on some form of maturity transformation. Most notably, banks use withdrawable deposits or short-term funding from other banks to finance long-term investments. This maturity mismatch generates liquidity risk, because when lenders demand their money back, a financial institution may have to rely on functioning markets (e.g. the interbank market) to roll over their debt or to sell some long-term assets to other parties.

Individual decisions...

A given financial institution will typically make decisions with respect to the maturity mismatch and to the management of liquidity risk by relying on some sort of stable structure and relationships in the market place (although it will also generally make use of some stress scenarios). Typically, the institution would identify several isolated risk scenarios and take appropriate precautionary measures. For instance, the institution may consider the scenario where liquidity in the funding market dries up and conclude that it could solve the problem by selling assets. Thus, there is the implicit assumption that the funding market and market for the assets are not simultaneously hit.

...may imply a fragile overall system

Liquidity-related decisions by credit institutions, although rational and prudent at the individual level, may in aggregate lead to a fragile financial system. For instance, Hellwig (1995) has provided a theoretical example in which banks have only modest maturity mismatches, but the overall maturity mismatch of the financial system, as generated by the chain of financial institutions, represents systemic risk. Hence, individual institutions may fail to incorporate systemic risk into the choice of their maturity mismatch.

Likewise, the system-wide dimension of shocks is generally not sufficiently appreciated by financial institutions. Liquidity shocks tend to affect several institutions simultaneously and may have contagious effects. For instance, market rumours about the solvency of a bank may make it harder for this bank to re-finance itself and force it to sell off assets. However, market participants may worry that banks with a similar structure have the same problem and refuse to re-finance these banks as well. This creates a simultaneous sell-off of these banks' assets which tends to depress the market price (fire-sale asset prices), further aggravating the situation of the banks in question and other institutions that have similar assets. Hence, the liquidity problem of one bank spreads to other banks and ultimately becomes a solvency problem. Thus, from a systemic perspective, there is a concern that liquidity evaporates across several market segments with potentially catastrophic consequences (e.g. evaporation of liquidity in the interbank lending market). Financial institutions have generally considered liquidity risk only in an isolated manner and have failed to take into account the systemic dimension.

2. Limits to individual institutions' incentives to address systemic risk

Financial institutions impose an external cost on overall system stability when they go bankrupt and generate a severe market dislocation (e.g. by asset fire sales). In this respect, it is said that financial institutions will internalise such external costs only when they bear fully the systemic costs and take them into account when investing in robustness. In the case of full internalisation of external costs, the individual incentives of financial institutions would ensure that the system is (i.e. from a social viewpoint) robust enough. The relevant questions are thus to what extent financial institutions internalise external costs and what are the main determinants of the degree of internalisation.

At the outset, it is important to acknowledge that it is impossible to determine in isolation a financial institution's incentives to internalise the social costs of failure. Financial institutions, like any firm in any market, operate in a complex setting where the legal system, regulation and other governmental actions, customers and competitors all have an important impact on the degree to which external costs are internalised.

2.1 The internalisation of external costs at the firm level

Any firm that goes bankrupt will forego future profits and so should have incentives to invest in its survival. However, financial institutions may lack the incentives to sufficiently invest in robustness. Consider, for illustration, the case where there is only one bank serving an economy. When considering investment in robustness, the bank would undertake a cost-benefit analysis and relate the investment costs to the future profits it would forego when going bankrupt. However, the bank customers and wider society benefit from the banking service as well, and so would suffer from failure of the bank (this is the external cost of a bank failure). Ultimately, the degree to which the bank internalises these external costs depends on whether customers can "price in" the value they derive from ongoing bank services (demanding higher interest rates if the bank is less robust) and thereby can induce the bank to invest appropriately in robustness.[1]

In a world with multiple banks and asymmetric information, considerations with respect to product differentiation, market positioning and reputation potentially have a powerful impact on financial institutions' incentives to invest in robustness. Such considerations broadly impact on the conditions under which parties are willing to deal with a given financial institution. They also tend to be effective in the long run and hence might provide

(1) See Kim et al (2005) for an example of how borrowers may discipline banks to avoid losses and thereby to increase their robustness.

incentives to financial institutions to ensure their resilience to very infrequent extreme events.

However, this may not always be true. Indeed, in a highly competitive environment, financial institutions may not be able to afford to invest sufficiently in robustness, if this increases their cost base and implies that they cannot take on some desired risk. Concerns about (short- /medium-term) performance may thus weigh more than the consideration related to the remote probability of failure.

In addition, the fact that EEs in financial markets hit many institutions at the same time may also reduce incentives to invest in robustness, because the damage to reputation is likely to be lower when peers suffer similar problems. This is in contrast to other industries, where contagion effects are more limited and catastrophic events tend to hit a particular firm, but not the whole industry (e.g. a pharmaceutical firm that markets a new drug which turns out to have deadly side effects does not trigger a chain effect on its competitors).

In brief, one can conclude that financial institutions internalise the external costs associated with catastrophic risk only to a limited degree. This is due to frictions and transaction costs in markets and the financial system which prevent the different parties from "pricing in" the external costs.

2.2 The internalisation of external costs at the intra-firm level (corporate governance and stakeholders' incentives)

This section opens the black box of a financial institution and considers the organisational structure and the role of differing stakeholders, or corporate governance. Financial institutions must balance the interests and objectives of different groups. Typically, the various groups, or stakeholders, have incentives and objectives that follow from the structure of their claim and the pay-off function they face. Most importantly, the stakeholders who are in control in normal times – the shareholders and the managers – usually have incentives that are biased toward excessive risk-taking compared to the other stakeholders.

Risk-shifting incentives of shareholders. Shareholders have an asymmetric pay-off function because they profit fully from the "upside" of increased risk-taking but are partially protected from the downside due to limited liability (debt holders and depositors face the remainder of the "downside"). Hence, shareholders have a pay-off structure that resembles a long call option, and they tend to take on too much risk. Specifically, shareholders have insufficient incentives to deal with extreme events because they do not internalise the costs of such events, either to depositors and debt holders or to the financial system. Thus, the internalisation problem with respect to extreme events is aggravated in the case of shareholder control.

Manager incentives. The incentives of the managers and other risk-takers in financial institutions are partly defined by the remuneration scheme and broader career concerns (e.g. reputation and labour market opportunities). Remuneration schemes have often been tilted towards short-run gains. Moreover, remuneration cannot be negative, which implies that managers have a long call-like pay-off function similar to that of shareholders. Moreover, job market opportunities may also favour short-term behaviour. In boom periods, managers who boost their institution's profits can increase their own "market value" significantly. In general, the time horizon of managers tends to be much shorter than the frequency with which extreme events occur, dampening the incentives to take precautions.

(Implicit) guarantees by authorities and third parties. Financial institutions and their stakeholders also enjoy explicit or implicit guarantees that provide incentives to disregard the "downside" of risky strategies. For instance, the implicit backing of a government in the event of failure may reduce institutions' incentives to invest in robustness. A government faces the fundamental problem of not being able to credibly commit itself to not bailing out financial institutions. In addition, even in a crisis, a government may need to rely on the knowledge and skills of the existing management and may consequently be unable to adequately "punish" them (Acemoglu, 2009).

As an example of the importance of intra-firm incentives, consider the current debate on the shortcomings of the corporate governance of large banks as listed public companies. More specifically, the concern is about the shareholder-value orientation and the shortcomings of executive pay. Commentators (from business, academia and the regulatory sphere) often argue that other corporate governance forms, such as partnerships, would provide better incentives for the decision-makers with respect to risk-taking.[1] The debate is far from over, but suggests that corporate governance plays an important role for the incentives to invest in robustness.

(1) See Wired Magazine (2009); Glassman and Nolan (2009); Knowledge@Wharton (2009); Financial Times (2009); Wharton School (2005).

Box 2 – The importance of liquidity: maturity mismatch, liquidity risk and financial contracting (continued)

Considering the systemic relevance of the design of financial structure and claims (i.e. the maturity mismatch and short-term nature of funding), what are financial institutions' incentives to choose an appropriate design for financial contracts?

Financial contracting and liquidity risks

Basically, financial contracting must take into account asymmetric information and the resulting potential for adverse behaviour of contracting parties. As a solution, liquidation threats can play an important role as a discipline device in the design of financial claims. For instance, the fragility of financial institutions through the nature of demandable debt (deposits) may be considered to be a direct response to alleviating the agency problems of banks. The capital structure determines their fragility due to the liquidation threat and is therefore a device with which to discipline managers (see Calomiris and Kahn, 1991; Diamond, 1984). Fragility of banks may also fulfil other roles, such as providing a commitment device for bank managers to provide liquidity (Diamond and Rajan, 2000, 2001). Other examples of liquidation/withdrawal threats are investors in their role as limited partners in partnerships (e.g. hedge funds – see Shleifer and Vishny, 1997); and prime brokers who may withdraw their funding from traders/hedge funds. Thus, withdrawal threats are a double-edged sword. On the one hand, they are a valuable disciplining device for managing agency problems in financial contracting. On the other hand, they give rise to systemic fragility and channels of contagion.

Incentives for proper liquidity management

In addition, the question of the incentives for financial institutions to appropriately manage liquidity risk surfaces. Maintaining a high level of liquid assets is costly for financial institutions (more liquid assets allow for a greater degree of freedom and hence are more expensive than illiquid assets – see Jones and Ostroy, 1984), but liquidity turns out to be very valuable in an extreme event where many asset classes except the more standard and robust ones are becoming illiquid. Hence, there may be a concern that some financial institutions under-invest in liquidity. Similarly, financial institutions' business model decisions may also reflect insufficient incentives to invest in robustness. Take the case of institutions like Northern Rock or Hypo Real Estate (HRE), which relied almost entirely on wholesale funding (and issuance in the covered bond market) and were highly dependent on liquidity in these markets.

3. Policy examples

Financial policy-makers around the world are currently proposing a wide range of regulatory and supervisory measures to restore the normal functioning of the financial system. Note, however, that policymakers are constrained in the choice of measures. Feasible measures include those that target the business model (e.g. permission to open branches), the legal or the organizational form of financial institutions and quantitative/nominal restrictions (e.g. capital requirements or limits on growth rates). This section presents some specific examples and discusses how they can improve risk modelling and/or incentives, in order to reduce the likelihood of extreme events in the future.

3.1 Macro-prudential supervision

The possible realisation of an extreme event demonstrates that the prudential control framework needs to rest on two complementary pillars: a powerful micro-prudential function focusing on the stability of individual institutions but also a strong macro-prudential function, concentrating on systemic stability. Indeed, the fundamental characteristic of a macro-prudential approach is to take a

system-wide view with respect to the distribution of risk in the financial system, both at a given point in time (cross-sectional distribution) and over time (pro-cyclicality). In addition, the micro- and macro-prudential control functions are not only complementary but they also reinforce each other. Macro-prudential analysis allows micro-prudential supervisors to better identify possible weaknesses of individual banks. Conversely, macro-prudential analysis can not be undertaken in isolation and should rest on micro-prudential data and close contacts with the supervisors. For this reason, it is very important for the supervisory architecture to foster strong and regular interactions between those involved in micro- and macro-prudential supervision.

In this respect, the recent de Larosière Report makes some important proposals.[1] First, the report calls for the creation of a European System Risk Council (ESRC) under the auspices of the European Central Bank. The objective of the ESRC – which could be compared to a "systemic risk supervisor" – would be to improve macro-prudential supervision in Europe. In addition to the ESRC, the de Larosière Report recommends establishing a European System of Financial Supervisors (ESFS). This framework will further foster co-operation between micro and macro prudential authorities. Finally, the report also calls for more important role of the International Monetary Fund (IMF) in tracking and controlling systemic risk. Specifically, the IMF should operate a global financial stability early warning system to track systemic risk and should support efforts of the international community to deal with jurisdictions with weak regulatory standard.

3.2 System robustness

One of the properties of a complex adaptive system is that not all nodes in the system have equal importance for the stability of the system, since some systemically important players will endogenously develop. Therefore, the concern of macro-prudential authorities on robustness of the system also implies that they should be able to assess and include the impact of these players on the robustness of the system in their analysis. Similarly, the nature of complex adaptive systems suggests that all systemically important institutions should be subject to micro-prudential control, and this holds independently of their legal form or activities. As a consequence, the perimeter of the regulatory and supervisory framework should be based at least in part on the significance of financial institutions for the robustness of the system. In other words, the question of whether a given institution should be regulated (and how) should not only depend on the legal structure or institutional form, but also on its systemic importance. In this respect, market observers have raised some specific issues:

The "shadow" banking system. In recent years, unregulated financial institutions such as hedge funds, private equity firms or structured finance vehicles, have gained significant importance in the financial system. Structured finance vehicles contributed significantly to the crisis. Although they allowed large banks to seemingly unload credit risk, they were also plagued by the same vulnerabilities as regulated institutions, namely a high maturity mismatch, high leverage and hence liquidity risk.

Hedge funds have also gained in importance, and it is still not clear whether they have contributed to the actual crisis. They have become significant players in many market segments and tend to be highly leveraged, which implies that they can potentially cause or amplify severe shocks. Moreover, their activities are highly opaque, which makes external risk assessment very difficult. Hence, regulatory efforts have been undertaken to improve transparency and "indirect regulation", with the aim of better assessing risk concentration in the system and ensuring that counterparties do not provide excessive leverage to hedge funds. Discussion of regulation of hedge funds is also ongoing.

Systemically important institutions. Some market observers have also contemplated the introduction of special measures for systemically important credit institutions. One idea is to estimate measures of systemic risks for groups of institutions and then calculating the contribution of each institution to systemic risk. Systemically important institutions – which would be defined as those which contribute significantly to system-wide risk – might then be subject to special regulation. However, it may be quite difficult to make a clear delineation between systemically unimportant and systemically important institutions. Also, institutions may be individually insignificant but, collectively, systemically important (consider for instance the failure of the savings and loan associations in the US the associated crisis in the 1980's).

3.3 Pro-cyclicality

The dynamic and cyclical nature of the financial system has been the source of a great deal of attention by policymakers, especially as risk models – together with regulation based on these models – may have contributed to pro-cyclical behaviour; i.e., to a situation where

(1) The report is available at:
http://ec.europa.eu/commission_barroso/president/pdf/statement_20090225_en.pdf

the cyclical behaviour of financial institutions accentuates business cycles in the economy. At this stage, several proposals have been brought forward for dampening pro-cyclical behaviour in the financial system and/or for weakening the pro-cyclical effects of existing regulation. The proposed measures focus mainly on three areas: reducing the excessive cyclicality of capital requirements, introducing loan loss provisions and constraining and limiting the pro-cyclical effect of leverage and valuation. (1)

Indeed, measures targeted at reducing pro-cyclicality may contribute to a better macro-prudential governance of systemic risk and also address the incentive problems. Most extreme events in the financial system arise through the bursting of a bubble and are thus the result of collective overshooting behaviour (herding) of financial system participants.

If adequately designed, such measures may reduce the accumulation of systemic risk in the system. However, it is not yet clear whether such measures can be efficiently designed and whether they will be effective in preventing the accumulation of risk over time.

3.4 Introducing a central clearing party in CDS markets

Market infrastructure is also likely to play a role in the way in which financial institutions are able to internalize systemic risk. For instance, credit default swaps (CDS) are currently traded over the counter (OTC). OTC trading is inherently opaque and prone to operational and counterparty risk. As a consequence, counterparties trading CDS over the counter do not internalize the externalities of their bilateral agreements on other parties. Specifically, by selling credit default protection to a given party, the seller increases the counterparty risk to other parties which have previously purchased credit protection from this seller and whose contracts are still outstanding.

Policy makers are going to introduce a central clearing party (CCP) in the CDS market. A central clearing party will eliminate counterparty risks for the individual parties and allow for a more efficient governance of risk by netting the various bilateral contracts. Note, however, that the central clearing party must be robust. Otherwise, instead of counterparty risk, other risks stemming from a single-point-of-failure may arise. However, supervisors of financial infrastructure have experience in dealing with such risks from which regulators can benefit.

(1) See Financial Stability Forum (2009).

(2) See the article "Reforming remuneration schemes in the financial industry: some governance and implementation issues" in this FSR.

3.5 Improving corporate governance and incentives

As discussed above, the governance structure of financial institutions and their remuneration practices can have a strong impact on the risk taking incentives of the institution. In the current policy discussion, reforming remuneration schemes in large financial institutions is high on the agenda. (2) This is surely an important aspect of improving incentives, as this will shift the incentives of risk-takers within financial institutions towards long-term performance, internalizing to a better degree the externalities of systemic risk. Besides the structure of the remuneration scheme, other features of governance are likely to influence incentives and therefore deserve a careful assessment. For instance, the composition of the supervisory board, the role of shareholders, and the position of risk managers in the corporate hierarchy are all important determinants of the incentives of (publicly traded) financial institutions to invest in robustness.

Business model decisions and the choice of the corporate governance structure will also impact on the external costs that a failure of an institution imposes on the system. In this respect, policymakers may want to push institutions to organize their major business units as separate legal entities to facilitate the liquidation or sale of units in case of failure of the institution.

Conclusion

This article explores some of the factors that can underlie a build-up of risk in financial institutions and the system. One factor relates to the shortcomings of risk models and, in particular, the absence of a systemic dimension which would reflect the complexities and interdependencies within the financial system and the impact of the institutions' own behaviour on the system. Another factor concerns the inadequate incentives that financial institutions have to invest in preventing extreme events. The failure of an individual financial institution can have an impact on the entire financial system; however, financial institutions do not "internalise" the negative external costs they impose on other financial system participants and the wider economy when making decisions related to their robustness.

The extreme event which we have experienced in recent months has confirmed that a sound supervisory framework should rest on two strong pillars: namely the micro- and macro-prudential supervision. Authorities should therefore continue to invest in their prudential regulatory framework in order to further strengthen the supervision of overall system robustness (i.e. macro-prudential

supervision) as well as the supervision of individual financial institutions (micro-prudential supervision). In this respect, the recent de Larosière report recommends the creation of the European System Risk Council (ESRC) and the European System of Financial Supervisors (ESFS). This framework will further foster strong and regular interactions between those performing micro- and macro-prudential analyses.

Several other regulatory proposals will also contribute to an increase in robustness of the financial system. Proposals to introduce central clearing parties in CDS markets, to regulate the "shadow" banking system (e.g. hedge funds), and to apply specific measures to systemically important institutions reflect concerns about the cross-sectional distribution of systemic risk in the financial system. Proposals aimed at reducing the pro-cyclicality of behaviour of financial institutions address both the incentive problem and concerns about the time-dimension of systemic risk. Proposals for improving corporate governance aim at incentives to invest in robustness.

In conclusion, achieving robustness in the financial system is a complex task. For this, policymakers need a framework that not only focuses on risks related to individual institutions and continuously monitors systemic risk but that is also able to improve the regulation and incentive for individual institutions such that they operate in a way that contributes to the robustness of the financial system.

Bibliography

Acemogly, D. (2009), The Crisis of 2008: Structutral Lessons for and from Economics. mimeo.

Caballero, R. J., and A. Krishnamurthy (2008), Collective Risk Management in a Flight to Quality Episode. Journal of Finance 63 (5), 2195-2229.

Calomiris, C. W. and C. M. Kahn (1991), The Role of Demandable Debt in Structuring Optimal Banking Arrangements. American Economic Review 81 (3), 497-513.

Daníelsson, J. (2008), Blame the Models. Journal of Financial Stability 4 (4), 321-328.

Diamond, D. W. (1984), Financial Intermediation and Delegated Monitoring. Review of Economic Studies 51 (3), 393-414.

Diamond, D. W. and R. G. Rajan (2000), A Theory of Bank Capital. Journal of Finance 55 (6), 2431-2465.

Diamond, D. W. and R. G. Rajan (2001), Banks and Liquidity. American Economic Review 91 (2), 422-425.

Diamond, D. W. and R. G. Rajan (2001), Liquidity Risk, Liquidity Creation, and Financial Fragility: A Theory of Banking. Journal of Political Economy 109 (2), 287-327.

Financial Stability Forum (2009), Report of the Financial Stability Forum on Addressing Pro-cyclicality in the Financial System.

Financial Times (2009), A need to reconnect. 13 March 2009.

FSA. (2009), The Turner Review – A regulatory response to the global banking crisis.

Glassman, J. K. and W. T. Nolan (2009), Bankers Need More Skin in the Game. Wall Street Journal 25 February 2009.

Haldane, A. G. (2009), Why banks failed the stress test. Speech given at the Marcus-Evans Conference on Stress-Testing, 9-10 February 2009, Bank of England.

Hellwig, M. (1995), Systemic Aspects of Risk Management in Banking and Finance. Swiss Journal of Economics and Statistics 131 (4), 723-737.

Jones, R. A. and J. M. Ostroy (1984), Flexibility and Uncertainty. Review of Economic Studies 51 (1), 13-32.

Kambhu, J., Weidman, S. and N. Krishnan (2007), Part 3: Systemic Risk in Ecology and Engineering. New Directions for Understanding Systemic Risk 13 (2).

Kim, M., Kristiansen, E.G. and B. Vale (2005), Endogenous product differentiation in credit markets: What do borrowers pay for? Journal of Banking & Finance 29 (3), 681-699.

Knowledge@Wharton (2009), One Former Investment Banker's Take on Restoring the 'Financial Quality, Integrity and Soundness of Our System'.

Landau, J.-P. (2008), Extreme events in finance – some reflexions. Remarks by Jean-Pierre Landau, Deputy Governor of the Bank of France. Paris.

Rigotti, L. and C. Shannon (2005), Uncertainty and Risk in Financial Markets. Econometrica 73 (1), 203–243.

Shleifer, A. and R. W. Vishny (1997), The Limits of Arbitrage. Journal of Finance 52 (1), 35-55.

Wharton School. (2005), Financial Risk Management in Practice: The Known, the Unknown and the Unknowable. Conference summary.

Wired Magazine (2009), Recipe for Disaster: The Formula That Killed Wall Street.